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Description

Microgranulometry and Methods of Applications-

~~CROSS REFERENCE TO RELATED APPLICATIONS~~

~~[0001] — 4,929,079 May, 1990 Delfour, et al. 356/336; 4,205,384 May,
1980 Merz, et al. 702/29 6,301,953 October 2001 Zamfes, at al.
73/38; 6,386,026 May 2002 Zamfes at al. 73/152.04.~~

BACKGROUND OF INVENTION

[0002] During oil and gas exploration conventional granulometry analysis is a time consuming, logistically complex procedure. It requires the transportation and storage of a large number of samples of the rock cuttings produced during drilling to the laboratory. Conventional practice is to have a field worker manually scoop a shovel full of the cuttings as they fall off of the shaker table (the part of the drilling rig which separates the rock cuttings from the drilling fluid so that the fluid can be

reused). The sample shovel-full is poured into a canvas bag and transported from the well site (which is typically remotely located) to a laboratory. Conventionally, a series of tall, wide cylindrical containers are used to separate the cuttings by particle size and density. The sample is combined with water and poured into a container. At a predetermined interval the upper portion of the partially settled sample is siphoned off and allowed to settle in a second container. This procedure is repeated until the size of particle remaining in suspension is of a desired size. Next, all the containers are dried and weighed using an analytic balance. The quantity of specific grain sizes is tabulated for interpretation. It is impractical to perform conventional granularity analysis during modern high speed drilling. Consequently, various down hole logging tools are used in place of conventional granulometry analysis to assess ~~Porosity~~ porosity and ~~Permeability~~ permeability.

[0003] Exploration focuses on the productivity of a potential reservoir during the drilling of a well in an unconsolidated formation. Detailed rock sampling and a corresponding granulometry analysis are the most accurate and direct method for defining the potential production horizons. Granulometry properties provide the best information for estimating the ~~Porosity~~ porosity and ~~Permeability~~ permeability of a reservoir. Unfortunately, conventional granulometry is not used in the exploration of unconsolidated formations due to the logistical problems associated with it. Instead, ~~Logging~~ logging

properties (which are determined using down-hole tools) are substituted for granulometry parameters when calculating ~~Porosity~~ porosity and ~~Permeability~~ permeability. This produces less accurate information about a potential production zone.

[0004] In the proposed ~~Microgranulometry~~ microgranulometry, the apparatus and the process solve all the problems of conventional granulometry and produce useful, accurate information. Microgranulometry produces direct quantitative measurements of the ~~SHALE, SILT~~ shale, silt and ~~SAND~~ sand content of the formation sample.

SUMMARY OF INVENTION

[0005] The proposed ~~micro-granulometry~~ microgranulometry apparatus and process is capable of producing detailed results with a very small amount of cuttings. The micro sample is placed in micro tube ~~1 Fig. 1~~ 1 Fig. 1 and water is added. Then the aggregate is shaken and placed vertically in the ~~Microgranulometry~~ microgranulometry apparatus ~~Fig. 3~~ Fig. 3 for further analyses. The micro tube can be passed along one or more sensors ~~10, 11, 12, 13~~ 10, 11, 12, 13 and the results are recorded on a computer.

[0006] A microscopic analysis is performed by placing the micro tube ~~1 tube 1~~ 1 in front of the ~~Horizontal~~ horizontal microscope disclosed in ~~USA Patent Provisional Application Number 60/481408, EFS ID 48139, Horizontal Binocular Microscope~~

~~for vertically gravitated and floating samples~~ U.S. Patent Application Serial No. 10/711,435, Horizontal Binocular Microscope for Vertically Gravitated and Floating Samples.

This process will allow a technician to visually distinguish the horizontal borders of ~~Sand~~ sand at the bottom, ~~Silt~~ silt in the middle and ~~Shale/Clays~~ shale/clays on the top. In some cases the colloidal substance or hydrocarbons maybe visually distinguished. A ~~Measuring Scale~~ measuring scale is used to measure the vertical length of each substance in millimeters from the bottom of the test tube once the layers are defined. For example if the total sample placed in the tube, in dry condition is 50 mm and the ~~Sand~~ sand is 35 mm. The ~~Silt~~ silt is 5 mm. and the ~~Shale~~ shale is 10 mm, then the ratio is calculated as 35/50, 5/50, 10/50.

[0007] Also the results produced may be used in calculating the ~~Environmental Index~~ environmental index (pertaining to the energy of accumulation) and to the quantification of the ~~Relative Permeability~~ relative permeability disclosed by the author in patent No. US 6,301,953 B1, Date Oct. 16,2001, ~~Quantification of drilling mud cuttings characteristics as a measure of relative permeability~~ Quantification of Drilling Mud Cuttings Characteristics as a Measure of a Relative Permeability.

[0008] After the analyses the micro ~~tube~~ tube 1 may be stored for further review.

BRIEF DESCRIPTION OF DRAWINGS

- [0009] ~~Fig. 1~~ Fig. 1 is presenting a general view of a glass ~~tube 1~~ tube 1, which has a rectangular cross ~~section A-A~~ section A-A. This is a micro tube with milliliter ~~scale 2~~ scale 2. A small quantity of sample and water can be placed inside.
- [0010] ~~Fig. 2~~ Fig. 2 is presenting a side view of micro tube with prepared sample after shaking. ~~In FIG. 2~~ In Fig. 2 the ~~pebbles 7~~ pebbles 7 are at the bottom. A sequence of gravitationally separated particles in liquid media (from course to very fine) can also be seen in ~~FIG. 2~~ Fig. 2. These layers are: ~~pebble 7, sand 6, silt 5, clay 4, and water 3~~ pebble 7, sand 6, silt 5, clay 4 and water 3.
- [0011] ~~Fig. 3~~ Fig. 3 is presenting general view of apparatus. The ~~tube 8.3~~ tube 8.3 slides in rolling ~~holders 8 and 9~~ holders 8 and 9. The rolling holders consist of rolling ~~pivot 8.1~~ pivot 8.1 and are suspended by ~~spring 8.2~~ spring 8.2. The gamma source and ~~holder 10~~ holder 10 are placed in sliding contact with the sample ~~tube 8.3~~ tube 8.3. The sonic ~~source 11~~ source 11 is on the same side as the gamma source. The gamma ~~receiver 12~~ receiver 12 is placed opposite the source to receive the unabsorbed gamma rays. The sonic ~~receiver 13~~ receiver 13 is placed opposite the sonic source and receives the sonic signal. The vertical ~~screw 14~~ screw 14 controls the precise position of ~~tube 8.3~~ tube 8.3 relative to ~~sensors 12, 13~~ sensors 12, 13 and ~~sources 10, and 11~~ sources 10 and 11. The rotating ~~nut 15~~ nut

15 is turned by means of ~~sheave 16~~ sheave 16 on ~~shaft 17~~ shaft 17, which is brought in motion by ~~motor 18~~ motor 18.

[0012] ~~Fig. 4~~ Fig. 4 is presenting miniature ~~tube 28~~, tube 28, which is made from lead and will absorb most of the naturally occurring background gamma rays. The pulsing source is comprised of ~~motor 25 and axis 24~~ motor 25 and axis 24 that rotates ~~sphere 22~~ sphere 22 and it is comprised of a lead ~~cover 20~~ cover 20 and lead ~~wall 21~~ wall 21, which shield the gamma ray ~~source 23~~ source 23, 27 is gamma ray detector. ~~29~~ 29 are gamma beams.

[0013] ~~Fig. 5~~ Fig 5 is presenting the data table that shows the ~~columns 5.1~~ columns 5.1 - depth of the interval analyzed with Microgranulometry, ~~5.2~~ Gas microgranulometry, ~~5.2~~ gas bubbles concentration in the test tube, ~~5.3~~ Sand tube, ~~5.3~~ sand quantity in millimeters, ~~5.4~~ Silt millimeters, ~~5.4~~ silt quantity in millimeters, ~~5.5 shale/clay~~ 5.5 shale/clay quantities in millimeters.

[0014] ~~Fig. 6~~ Fig. 6 is presenting the results of Microgranulometry microgranulometry compiled in the Geological and Geophysical Log geological and geophysical log. On this log the Microgranulometry microgranulometry data are graphically presented.

[0015] ~~Fig. 7~~ Fig. 7 is presenting the full log. In ~~Fig. 7, 7.1~~ Fig. 7, 7.1 the textual and digital data. ~~Fig. 7, 7.2~~ Fig. 7, 7.2 the information is presented in the Lithological lithological column. The ~~Other Drilling and Gas~~ other drilling and gas logging

parameters are presented in graphical form as curves ~~Fig 7, 7.3~~
Fig. 7, 7.3.

DETAILED DESCRIPTION

- [0016] The proposed micro granulometry apparatus and process is capable of producing detailed results with very small quantities of cuttings. This micro sample is placed in micro ~~tube~~ tube 1 and water is added. Then the aggregate is shaken and placed vertically in the ~~Microgranulometry~~ microgranulometry apparatus ~~Fig. 3~~ Fig. 3 for further analyses where the micro tube is passed along one or more ~~sensors 10, 11, 12, 13~~ sensors 10, 11, 12, 13 and the results are recorded on the computer. Quarter inch lead shielding adequately blocks the background radiation noise, so that transient gamma radiation can be measured with enough resolution for distinguishing between sand, silt and shale. Good results been achieved in the field testing of the apparatus and process disclosed by the author in US Patent # 6,386,026, ~~Sample Catcher and Methods of Applications~~ Cuttings Sample Catcher and Method of Use and US Provisional Application Number ~~60481381~~ 60/481,381, Drilling Cutting Analyzer System and ~~methods of applications~~ Methods of Applications, also by the author.
- [0017] A microscopic analysis is performed by placing the micro ~~tube~~ tube 1 in front of the ~~Horizontal~~ horizontal microscope disclosed in ~~USA~~ US Patent Provisional Application Number

60/481408, ~~EFS ID 48139, Horizontal Binocular Microscope for vertically gravitated and floating samples~~ Horizontal Binocular Microscope for Vertically Gravitated and Floating Samples. This process allows a technician to visually distinguish the horizontal borders between the layers of ~~Sand~~ sand at the bottom, ~~Silt~~ silt in the middle and ~~Shale/Clays~~ shale/clays on the top. The variety of sizes of sand, from coarse to very fine, is easily recognizable under the horizontal binocular microscope making detailed and efficient description possible. The transition zone between the very fine sand and silt in aggregated sample is unrecognizable in conventional sample description. In ~~Microgranulometry~~ microgranulometry the very fine sand will float down faster than the silt. This is due to the sample being ground in a mortar and pestle during preparation. Thus the silt settles on top of the very fine sand. This makes the silt clearly definable and quantitatively measurable. Similarly the aggregated components of the sample are liberated during the sample preparation and separated by the ~~Microgranulometry~~ microgranulometry procedure revealing clearly definable layers. In the case of a calcareous cemented formation the sample can be washed with acid to dissolve the calcareous cement. The difference of volume (the observed height of the substance in the test tube) before and after washing yields a quantitative measure of calcareous cement. The ~~Bentonite~~ bentonite (and other clays that increase in volume when hydrated) component of the

sample can be quantitatively defined by the increase in volume of the contents of the test tube. This can be directly observed by the increase in height above the initial level in the test tube. In some cases the colloidal substance or hydrocarbons maybe visually distinguished. Heavy minerals will be clearly deposited at the bottom of the test tube. The microscopic observation under the horizontal microscope is very clear and detailed due to the optical properties of water. Gas bubbles may be observed on the walls of the test tubes and on the cuttings if the formation is gas bearing or overpressure gas is present in sample particles. Liquid hydrocarbons can be observed on the top of the water by using fluorescent properties of hydrocarbons. Here, UV light is used to induce fluorescence. A ~~Measuring Scale~~ measuring scale is used to measure the vertical length of each substance in millimeters from the bottom of the test tube after the contents have settled. For example, 35 mm, 5 mm and 10 mm measurements taken in a 50 mm high sample would be recorded as the ratios 35/50, 5/50, and 10/50. The results of ~~Microgranulometry~~ microgranulometry are compiled in the ~~Geological and Geophysical Log~~ geological and geophysical log Fig 6. On this log the ~~Microgranulometry~~ microgranulometry data are graphically presented ~~Fig 7, 7.1~~ Fig. 7, 7.1. The ~~Textual~~ textual and digital information is presented in the ~~Lithological~~ lithological column ~~Fig 7, 7.2~~ Fig. 7, 7.2. The ~~Other Drilling and Gas~~ other drilling and gas logging parameters are presented

in graphical form as curves ~~Fig 7, 7.3~~ Fig. 7, 7.3. The Petro-
~~physical~~ petro-physical calculations maybe performed in ~~Table~~
~~table~~ format with ~~Graphical~~ graphical correlations analyses ~~Fig.~~
~~5~~ Fig. 5. The ~~Data~~ data table presented in ~~Fig. 5~~ Fig. 5 shows
the ~~columns 5.1—Depth~~ columns 5.1 – depth of the interval
analyses with ~~Microgranulometry, 5.2—Gas~~
microgranulometry, 5.2 – gas bubbles concentration in the test
~~tube, 5.3—Sand~~ tube, 5.3 – sand quantity in ~~millimeters, 5.4—~~
Silt millimeters, 5.4 – silt quantity in ~~millimeters, 5.5—~~
shael/clay millimeters, 5.5 – shale/clay quantities in
millimeters.

[0018] Additionally, these results may be used in calculating the
~~Environmental-Index~~ environmental index of energy of
accumulation and for quantifying the ~~Relative Permeability~~
relative permeability disclosed by the author in patent No. US
6,301,953 B1, ~~Date~~ date Oct. 16, 2001, ~~Quantification of~~
~~drilling mud cuttings characteristics as a measure of relative~~
~~permeability~~ Quantification of Drilling Mud Cuttings
Characteristics as a Measure of Relative Permeability.

[0019] After the analyses the micro ~~tube 1~~ tube 1 may be stored away
for further review.

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~~Microgranulometry and methods of applications.~~

Abstract

~~We disclose an~~ An apparatus and process for measuring the granulometry separations in discrete media and unconsolidated sediments for relatively small sample quantities (5cc containers of drilling cuttings) is disclosed. A small diameter glass tube may be filled with a small amount of sample, and water added. After shaking ~~it~~ and placing it vertically, the larger, denser particles will settle near the bottom. Particle size will tend to decrease in size towards the top. Placing the tube near an array of sensors may perform a quantitative analysis. ~~These include but are not limited to~~ such as sonic, gamma and optical sensing. One or more sensors are slowly moved past the tube and digitized readings be recorded. The collected readings are interpreted by the quantity and sizes of particles and by their distribution. The results may be presented in various ways. ~~Also the results produced may be~~ and used to calculate the ~~Environmental Index~~ environmental index of energy of accumulation and to quantify the relative permeability of a potential reservoir ~~(as disclosed by the author in patent No. US 6,301,953 B1, Date Oct. 16, 2001, Quantification of drilling mud cuttings characteristics as a measure of relative permeability.~~